the monitor of electronics recycling issues

CRT Glass to CRT Glass Recycling

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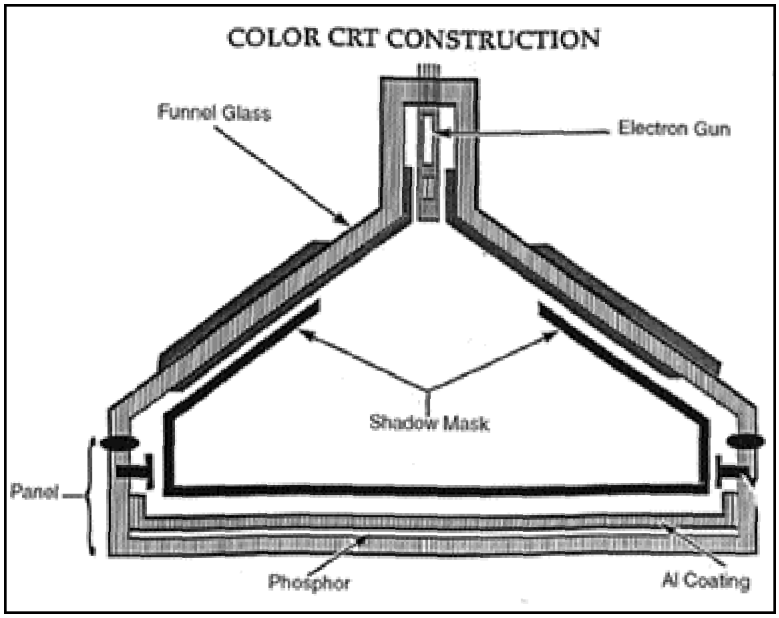
A cathode ray tube (CRT) is the video display component of television and computer monitor. A typical CRT contains between 15 and 90 pounds of glass. Lead and other elements are added to the specialized CRT glass to protect the user from x-rays generated within the operating CRT. Some CRT glass is comprised of 25% lead oxide (PbO). Because of the high lead content, CRT glass should not be disposed of in the trash or municipal landfills. While CRT glass may be disposed of in hazardous waste landfills, recycling is the preferred management option for end-of-life CRTs. This fact sheet provides an overview of the CRT glass to CRT glass recycling process, hereafter referred to as glass-to-glass recycling. For more information on handling waste CRTs, please view the CRT fact sheet on the CA Department of Toxic Substance Control (DTSC) web site: http://www.dtsc.ca.gov/docs/hwmp/docs/HWM_FS_CRT-EmergencyRegs.pdf.

CRT Constituent Materials



Glass Components

Panel Glass
The panel or screen makes up the front of the CRT and accounts for two-thirds of the CRT's mass. In late model CRTs the panel glass contains barium oxide instead of PbO.

Funnel Glass
The rear portion is referred to as the bell or funnel. Funnel glass is leaded glass; most of the lead in a CRT is in the funnel glass.

Neck
The neck is the straight glass tube that surrounds the electron gun(s). The neck is made of leaded glass.

Solder Glass
The solder glass or frit is used to seal the CRT. Frit is 85% lead.

Non-Glass Components - must be removed prior to glass-to-glass recycling

Banding
Metal banding reinforces the CRT. It must be removed prior to recycling.

Electron Gun
The stainless steel electron gun creates the electron beam.

Shadow Mask
The shadow mask is a metal screen that focuses the electrons on the back of the panel.

Yoke
The coils of copper wire around the neck of the CRT are known as the yoke; the yoke is an electromagnet that deflects the electrons to the proper position on the panel.

Phosphor Coating
Special compounds adhered to the inside of the panel; they procude light when struck by the electron beam.

What is Glass-To-Glass Recycling?

Glass-to-glass recycling refers to the closed loop recycling process of reclaiming leaded CRT glass from end-of-life CRTs and using it to make new CRT glass. Glass-to-glass recycling involves collecting televisions and monitors, removing and crushing the CRTs, separating the glass from the non-glass materials, processing the glass to meet specifications, and using the glass as an ingredient to manufacture new CRT glass.

Glass-to-glass recycling has several benefits. In addition to removing lead from the municipal waste stream, glass-to-glass recycling avoids the environmental impacts associated with mining and processing raw lead from ore by supplying lead (in the form of CRT glass) for CRT glass manufacturing. In California, CRTs that are destined for glass-to-glass recycling may be managed as universal waste, rather than hazardous waste (see DTSC fact sheet for clarifications).

The major CRT glass manufacturers in the United States are Techneglas, American Video, Corning Ashai, and Thompson Electronics. Because these manufacturers no longer make CRT glass for monochrome CRTs, monochrome monitors are best recycled by other methods (e.g., lead smelting) in this country.

Preparing CRTs for Glass-to-Glass Recycling

Step 1: Remove CRT from the monitor or television

Step 2: Remove all non-glass material from the exterior of the CRT.

Step 3: Release the vacuum from the CRT.

Step 4: Crush CRT and separate any remaining metals from glass.

Step 5: Remove phosphorescent coatings and prepare uniform cullet.

CRT Recycling Economics

CRT recycling produces three types of commodities: metals, plastics and glass. CRTs alone produce steel and glass; complete monitors and TVs produce various metals, plastics and glass.

Metals

Negligible amounts of metals such as copper, nickel and steel, can be recovered from CRTs. Newer models yield less precious metals than older ones. The copper wire yoke and the shadow masks are also presumed to be hazardous waste. At a minimum, recyclers of this material will be classified as generators by CA DTSC .

Plastics

High-value engineering plastic resins such as high-impact polystyrene (HIPS), acrylonitrile-butadiene styrene (ABS) and polycarbonates (PC) are sold to some domestic markets. MBA Technologies, located in Richmond, CA, have developed a process to recycle these plastics. However, most plastics are exported to international markets.

Glass

CRT glass recyclers separate cullet into the following streams:

- Broken Color Dirty Mix – without metals
- Broken Color Dirty Mix – with metals
- Dirty Sorted Funnels
- Monochrome CRTs
- Dirty Broken Panels
- Dirty Whole Panels
- Whole CRTs

"Mix" refers to panel and funnel glass combined; "dirty" refers to glass with coatings. Broken Color Dirty Mix - with metals is broken CRTs with the banding and masks. Broken Color Dirty Mix - without metals is color CRT's that have metal banding, gun and mask removed. Rubber stoppers under the yolk also need to be removed. Dirty sorted funnels and panels must be free of all metals except pins molded

into the glass pieces. Panel received with frit is considered Broken Color Dirty Mix- without metals. Frit with funnel is accepted as sorted funnel.

Typically, the market value of these commodities do not cover the cost of CRT recycling which includes packaging, transportation, dismantling, and processing the materials. The current value of CRT glass cullet averages $180/ton. Processing CRT glass alone costs $100/ton, and this figure does not include costs for packaging, transportation and dismantling the monitors and TVs.

US Glass-to-Glass Recyclers

NXTCYCLE, a division of National Environmental Waste, has processing facilities in Phoenix and Utah. NxtCyle also has collection centers in Salt Lake City, Utah; Whittier, California; and Laredo, Texas. Nxtcycle plans to set up collection centers in the San Francisco Bay Area, Portland, Seattle, Denver, San Diego and Los Angeles.

Materials collected by Nxtcycle are dismantled by prison inmates at the Gunnison State prison in Utah. The prison inmates disassemble approximately 20,000 monitors per month. A per-monitor fee is charged for this processing. An auto shredder is used for some CRT components and the residual fluff is sent to the Butterfield Landfill. All ABS and HIPS plastic housing is recycled domestically. CRT glass recovered by Nxtcycle is sent to Envirocycle for processing.

DLUBAK GLASS is the largest glass recycler in the country, Dlubak handles automotive glass, lighting industry glass, and CRT glass. Besides automakers, Dlubak's end markets include Corning, Philips, Sylvania, IBM, Thompson, Panasonic, Toshiba, and Hitachi. The company currently handles 300,000 tons of glass per year and employees approximately 50 workers in the US.

NxtCycle Pricing Structure for California

Northern California:

Monitor or TV under 36"	$6.00/unit
Monitor or TV over 36"	$8.00/unit
CRT tube only	$3.00/unit
Transportation per truck	$800.00 ea.

Properly loaded containers hold 500 to 600 units under 36".
Cost/unit on an average of 550 units per truck is $1.60/unit.

Net cost to any supplier in Northern California:

Monitor or TV under 36"	$6.00 + $1.60 = $7.60/unit
Monitor or TVover 36"	$8.00 + $1.60 = $9.60/unit
CRT tube only	$3.00 + $1.60 = $4.60 /unit

Southern California:

Monitor or TV under 36"	$6.00/unit
Monitor or TV over 36"	$8.00/unit
CRT tube only	$3.00/unit
Transportation per truck	$950.00 ea.

Properly loaded containers hold 500 to 600 units under 36".
Cost/unit on an average of 550 units per truck is $1.70/unit.

Net cost to any supplier in Southern California:

Monitor or TV under 36"	$6.00 + $1.70 = $7.70/unit
Monitor or TVover 36"	$8.00 + $1.70 = $9.70 /unit
CRT tube only	$3.00 + $1.70 = $4.70 /unit

Several studies have indicated that the average weight per unit is about 65 lbs. The per ton charge for each truck is:

Monitors & TVs	18 tons/truck (x) $180/ton = $3240.00
Transportation Cost	18 tons/truck (x) $45/ton = $810.00
Current Capacity:	10,000 units/month
	18 truckloads

(prices current as of 9/2001)

Five employees handle CRT recycling at the Dlubak site in Sandusky, Ohio. The site handles 20 to 30 truckloads per day. CRTs are demanufactured by US Federal Prison Industries, also known as UNICOR. Dlubak's partnership with UNICOR provides dismantling for funnel and panel glass, ferrous and non-ferrous metal removal for all non-glass materials and panel glass sorting by materials.

The Dlubak Glass parent company is located north of Pittsburgh in Natronia Heights, Pennsylvania. Dlubak also has facilities located in Pennsylvania; Ohio; Detroit, Michigan; Evansville, Indiana; Knoxville, Tennessee; Nashville, Tennessee; Lawrenceburg, Kentucky and south of Tulsa, Oklahoma.

ENVIROCYCLE, a company of the Matco environmental group, has recycled CRTs since 1991. Envirocycle operates facilities in Hallstead Pennsylvania and Stowe, Ohio and will soon open a facility in North Carolina.

All materials received by Envirocycle are inspected for the possibility of resale. Units with no value are sent to be dismantled and sorted into the proper material streams for recycling. The average time for pro-

cessing CRT glass is 2 weeks. Within one month the cullet is back into the commerce stream as a new CRT. Envirocycle employs approximately 50 people in their tear-down process and is currently investing in research and development to improve the dismantling technology.

End Markets

TECHNEGLAS, started in 1946 as Owens-Illinois TV Products Division, is a leading supplier of CRT glass for television picture tubes. In 1988 Owens-Illinois (OI) and Nippon Electric Glass (NEG) formed a joint venture: OI-NEG TV. In 1993 OI-NEG became a wholly-owned subsidiary of NEG and was renamed Techneglas. In 1994 Techneglas was the first television glass manufacturer in the world to convert 100% of its glass funnel melting process to an environmentally-safe, oxygen-gas firing system. Techneglas has sold enough glass parts to manufacture more than 235 million television picture tubes.

Envirocycle Pricing Structure

Type	Return	Charge
Dirty Sorted Funnel	$80.00/ton	xxx
Dirty Whole Panel	$60.00/ton	xxx
Broken Panel	$40.00/ton	xxx
Broken Color Dirty Mix – without metals	xxx	No Charge
Broken Color Dirty Mix – with metals	xxx	$100.00/ton
Whole Bare CRT's	xxx	$2.50/truckload
Broken Mixed Color/ Monochrome	xxx	$325.00/ton

(prices current as of 9/2001)

Shipping Requirements

CRTs are typically packed in gaylords or trays. Broken CRT glass should be shipped in a 4x4x4 triple-walled gaylord box on a sturdy pallet. Whole CRT panels should be stacked on pallets with cardboard between layers. Broken glass in other packaging may incur additional expense or be returned at customer's expense. Transportation costs to the recycling facility are the responsibility of the customer.

Please note: *Pricing information provided in this factsheet is subject to change without notice. Contact recyclers to discuss terms prior to shipping materials.*

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